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BULLETIN

OF THE

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Vol. 50 No. 5

BULLETIN

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TORREY BOTANICAL CLUB

MAY, 1923

Studies in the genus Lupinus—VIII. Lupinus nanus

CHARLES PIPER SMITH

(WITH SIX TEXT FIGURES)

The single species treated herein is the largest-flowered species of the *Micranthi*, the specific name applying to the stature of the plant, in its reduced forms, and not at all to the size of the flowers.

1a. LUPINUS NANUS Dougl.; Benth. Trans. Hort. Soc. Lond. II. 1: 409. 1835. [FIG. 79.]

Lupinus affinis Agardh, Syn. Gen. Lup. 20. 1835.

Annual, erect, 20–60 cm tall, simple or branched at the base, more or less villous and minutely spreading- or appressed-pubescent; leaves well scattered, or crowded by the development of axillary clusters; petioles slender, 4–8 cm. long; stipules subulate, 4–8 mm. long; leaflets five to seven, linear to spatulate, acute to rounded at the apex, 15–30 mm. long and 3–10 mm. wide (rarely 30–45 × 10–16 mm.); peduncles 4–8 cm. long, scarcely surpassing the foliage; racemes 6–20 cm. long, loosely flowered; flowers whorled, 10–16 mm. long; bracts deciduous, linear-lanceolate; pedicels slender, 5–8 mm. long; calyx bracteolate, its upper lip bifid, 4–5 mm. long, lower lip usual y two- or three-toothed, 5–8 mm. long; petals broad, rich blue except the banner-spot which is first white or yellow, changing to violet, banner suborbicular, 11–15 mm. wide, 10–14 mm. long, often emarginate at apex, much reflexed, wings mostly concealing the keel, which is slender, usually not much curved, ciliate on the upper edges of the slender apex; pods appressed-pubescent, 20–35 mm. long, 4–6 mm. wide, ovules usually four to eight (rarely eight to twelve); seeds 2–3 mm. long, usually well marked

[The BULLETIN for April (50: 133–158. *pl.* 5–7) was issued April 7, 1923.]

with brown or dark gray mottling;* tap root slender and much shorter than the stems.

Like *Lupinus sparsiflorus* Benth., this is a composite species exhibiting conspicuous and often confusing variations, apt to be misunderstood and treated as "new species." Its resemblance to *L. sparsiflorus* was noted by Bentham, who characterized the latter as:

Flores iis *L. nani* subsimiles, omnes alterni v. rarius hinc inde aproximati.

Should the opposing characters of flowers verticillate versus flowers non-verticillate at any time fail, the two species may be easily separated by the decided difference in the ciliation of the keel. Apparently their ranges do not overlap, unless, perhaps, in Ventura County.

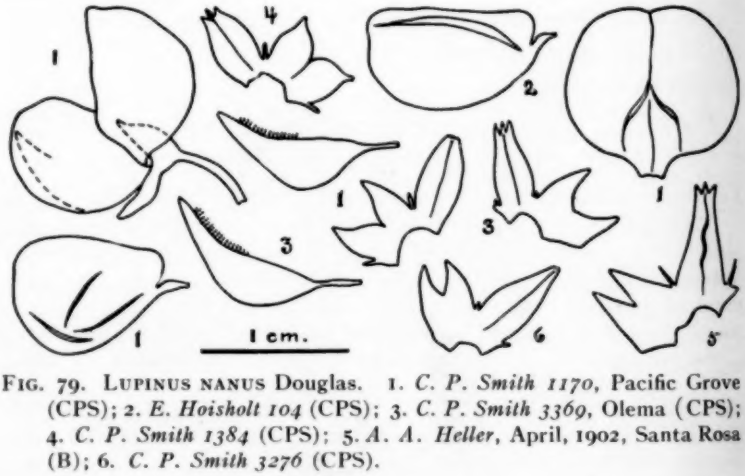

FIG. 79. LUPINUS NANUS Douglas. 1. *C. P. Smith 1170*, Pacific Grove (CPS); 2. *E. Hoisholt 104* (CPS); 3. *C. P. Smith 3369*, Olema (CPS); 4. *C. P. Smith 1384* (CPS); 5. *A. A. Heller*, April, 1902, Santa Rosa (B); 6. *C. P. Smith 3276* (CPS).

Though Bentham's original characterization of *L. nanus* is brief, he has given enough description to make recognition of the typical form a reasonable possibility. Extracts from his description follows:

Annuus humilis pilosiusculus, caulibus decumbentibus parum ramosus . . . foliolis 5–7 spathulatis . . . floribus subverticillatis . .

* At Felton, Santa Cruz County, a peculiar strain was found in which the seed varied from pale bluish-white or flesh-colored, unmarked, through various patterns and shades to a practically solid black, the color or pattern being quite constant for each individual plant.

labio superiore bifido inferiore longiore integro . . . flowers about the size of those of the annual lupin, but more elegant from their number and variagated colours.

Agardh's monograph accounts for *L. nanus*, but he evidently did not have access to Bentham's description, for he credited Swartz as authority for his cited reference. His description (Syn. Gen. Lup. 11. 1835) is more comprehensive than Bentham's but is based upon specimens seen in Lindley's herbarium. He included the species in his "Tribe D—*Angustifolii*." Extracts from this treatment follow:

L. nanus Dougl. mscr. Benth. in Hort. Trans. n.S.v.1. p. 409 t. 14 f. 2 (fide Sw.) Sweet. Britt. Flow. Gard. 2 ser. fol. 257. . . . caulis . . . patenter pilosus . . . foliola 7-nata lanceolato-linearia, extus paululum latiora . . . utrinque pilis patentibus obsito . . . verticillis sub- 5-floris, distantibus . . . calyx ebracteolatus . . . labio superiore subbipartito inferiore emarginato . . . vexilli disco purpureo-punctato . . . leguminibus glabris. Hab. in California legit Douglas; Specimina e seminibus inde reportatis, in Horto Hortic. Society enata, vidi in col'ectione Lindleyi.

Included in his "Tribe G—*Nootkatenses*," on page 20 of his monograph, Agardh presented his *L. affinis*. This he compared with *L. nootkatensis* and *L. perennis* and associated same with species not at all related to this or to each other. As explained in my last paper of this series, this Agardhian name has been applied by American botanists to a very distinct Californian species, to which I have had trouble in fitting Agardh's description. This should, however, be carefully compared with his own characterization of *L. nanus*, and for this purpose I quote liberally, as follows:

33. *L. affinis* nob. caule herbaceo patenter pilose, foliolis 7 obovatis basique utrinque pubescentibus . . . calycibus verticillatis bracteolatis . . . labio superiore profunde bifido, carina ciliata.

? L. Nootkatensis var. Hook. Fl. Bor. Amer. IV. p. 163. Bot. Mag. t 2136.

Hab. in California, unde specimina a Douglasio reportata vidi in Herb. Lindleyi. (Ad Nootka et in Rocky Mountains, si synonyma allata huc pertinent).

Caulis decumbens videtur et herbaceus. Foliola obovata . . . utrimque pubescentia . . . Racemus laxus. Flores verticillati. Corolla . . . coerulea, vexilli medio flavicante.

Careful comparison of these two descriptions gives me no satisfactory evidence that two distinct species are being treated. Bentham refers to the leaflets of *L. nanus* as "foliolis 5–7

spathulatis," and Dr. Jepson has annotated the University of California sheet of Heller's 6571, from near Monterey, thus: "Leaves like leaves in *L. nanus* type, but a trifle larger. W. L. J., Kew, 1906." The leaflets in this specimen are spatulate or nearly so. However, Miss Eastwood's photo marked, "*Lupinus nanus*, ex Herb. Benth.", shows slender plants with leaflets oblanceolate and linear-oblanceolate, thus agreeing with Agardh's characterization of *L. nanus* where he says, "foliola . . . lanceolato-linearis." Then Agardh attributed to his *L. affinis*, "foliolis 7 obovatis;" but Miss Eastwood's photos, which are marked "*Lupinus affinis* Agardh, ex Herb. Lindl.," plainly show plants of *L. nanus*, one collected by Douglas, with spatulate leaflets, and two, one each by Hartweg and Douglas, with linear oblanceolate leaflets. Further, my study of many sheets of more recent specimens, together with considerable field experience with these variations and also with even greater extremes, has convinced me that it is certainly impracticable, if not quite impossible, to maintain a distinction between *L. nanus* and *L. affinis*. I might also add that "caule . . . patenter pilose" and "foliolis . . . utrinque pubescentibus," said of *L. affinis*, apply to *L. nanus* and not to the *L. succulentus* Dougl., known, since Watson's time, as *L. affinis* Agardh.

Nevertheless *L. nanus*, as I understand it, includes a few recognizable varieties which will be indicated after citing a representative selection from the more than one hundred sheets I have referred to the species, *sensu strictiore*.

CALIFORNIA: Alameda County: Berkeley, April, 1898, *J. B. Davy* (UC.); Oakland, March, 1864, *W. H. Brewer 2775* (CA, UC); same, July, 1901, *H. A. Walker 662* (BP). Butte County: Chico, April, 1914, *A. A. Heller 11311* (CA, DS); De Sable, June, 1917, *Helen M. Edwards* (DS); Oroville, March, 1913, *A. A. Heller 10685* (CPS, DS). Calaveras County: Mokelumne Hill, *F. E. Blaisdell* (CA). Contra Costa County: Point Isabel, April, 1897, *J. B. Davy* (UC). Lake County: Lower Lake, May, 1902, *Agnes M. Bowman 255* (DS); Weldon Valley, April, 1902, *Agnes M. Bowman 222* (DS). Marin County: Ignacio, April, 1918, *L. R. Abrams 6896* (DS); Kentfield, May, 1912, *A. Eastwood 11* (CA); Lagunitas, April, 1918, *F. Grinnell, Jr.* (DS); Olema, April, 1886, *E. L. Greene* (UC 196349); Point Reyes, May, 1906, *A. Eastwood* (CA); Sausalito, June, 1912, *A.*

Eastwood (CA). Mendocino County: Handley's, May, 1903, *J. I. McMurphey 146* (DS); Ukiah Valley, April, 1918, *L. R. Abrams 6979* (DS). Monterey County: Carmel Highlands, March, 1921, *C. P. Smith 3238* (CPS); Carmel Valley, July, 1906, *E. A. McGregor 78* (DS); Los Burros trail, Santa Lucia Mountains, May, 1897, *A. Eastwood* (CA); Jolon, April, 1915, *A. Eastwood 4129* (CA); Pacific Grove, *I. Tidestrom* (UC); Salinas, May, 1921, *J. C. Menker 101* (CPS); Seaside, April, 1903, *A. A. Heller 6571* (B, BP, DS, UC). Napa County; Calistoga, April, 1903, *C. F. Baker 1990* (B, BP, CA, UC); same, *J. P. Tracy 1847* (UC 156988 and 156989); Oakville, April, 1893, *W. L. Jepson* (UC). San Benito County; San Juan, May, 1903, *A. D. E. Elmer 4668* (BP, CA, DS, UC). San Francisco County: Forest Hill, April, 1921, *Bertha Dold 102* (CPS); Ocean View, April, 1894, *W. R. Dudley* (DS); Presedio, April, 1902, *C. F. Baker 698* (BP, CA, UC); Sand Hills, May, 1903, *C. F. Baker 2996* (BP, CA, UC). San Luis Obispo County: Arroyo Grande, April, 1861, *W. H. Brewer 451* (CA, UC); Paso Robles, April, 1899, *J. H. Barber* (UC); same, May, 1903, *G. B. Grant* (B); Point Harford, April, 1902, *W. R. Dudley* (DS); San Simeon, Aug., 1885, *T. S. Brandegee* (CA). San Mateo County: Baden, May, 1899, *W. R. Dudley* (DS); Crystal Springs Lake, April, 1903, *C. F. Baker 471, 1928* (BP); Lake Merced, April, 1907, *A. A. Heller 8452* (B, DS); Montara, May, 1912, *W. A. Setchell* (UC); Pescadero, April, 1896, *W. R. Dudley* (DS); San Gregorio, April, 1902, *C. F. Baker 507* (BP, UC). Santa Barbara County: without locality, May, 1902, *A. D. E. Elmer 4142* (DS). Santa Clara County: Betabel, April, 1921, *C. P. Smith 3263* (CPS); Gilroy Hot Springs road, April, 1921, *Mrs. V. Dold 101* (CPS); Madrone, April, 1921, *C. P. Smith 3276, 3279* (CPS); Palo Alto, May, 1893, *I. Tidestrom* (UC); Stanford University, May, 1902, *C. F. Baker 844* (CA, UC). Santa Cruz County: Capitola, April, 1903, *C. F. Baker 1964* (BP, CA, UC); Felton, May, 1921, *Estella Hoisholt 104* (CPS); Santa Cruz, April, 1897, *W. A. Setchell* (BP, UC). Sonoma County: Bodega, July, 1905, *K. Brandegee* (UC); Bodega Point, June, 1915, *A. Eastwood 4842* (CA); Healdsburg, April, 1902, *A. A. Heller 5233* (B, BP, DS, UC); Petaluma, April, 1908, *C. P. Smith 1384* (CPS); Santa Rosa, April, 1921, *A. Eastwood 10332* (CA). Tulare County: Kaweah

River Basin, April, 1901, *R. Hopping 97* (BP). Tuolumne County: top of Table Mountain, above Rawhide, April, 1919, *R. S. Ferris 1494* (CA, DS).

Key to the varieties of Lupinus nanus

Densely villous with many hairs 2–3 mm. long; flowers 14 mm. long, wings about 10 mm. wide, keel strongly arcuate; pods 6 mm. wide, ovules six to seven; seeds 4 mm. long, 3 mm. wide..... *1b.* var. *perlasius.*

Loosely villous or appressed pubescent, no hairs over 1.5 mm. long.

Seeds 4–5 mm. long; pods 7–9 mm. wide, 30–50 mm. long; largest leaflets 7–15 mm. wide, 25–50 mm. long..... *1c.* var. *carnosulus.*

Seeds 1.5–3.5 mm. long; pod 3–6 mm. wide.

Ovules usually eight to twelve; seeds 1.5–2 mm. long, pale flesh-colored, more or less obscurely marked; pods 3–4 mm. wide..... *1d.* var. *Menkerae.*

Ovules usually four to eight (rarely more); seeds 2–3.5 mm. long; pods 4–6 mm. wide.

Flowers 11–16 mm. long; keel usually not strongly arcuate..... *1a. L. nanus.*

Flowers 6–10 mm. long; keel usually strongly arcuate.

Seeds flesh-colored, more or less obscurely marked with darker; banner usually wider than long, little reflexed, its apex barely 2 mm. from upper distal united corners of wing petals..... *1e.* var. *vallicola.*

Seeds gray, much mottled with brown; banner as long as wide, well reflexed, its apex more than 2 mm. from upper distal united corners of wing petals..... *1f.* var. *apricus.*

1b. **Lupinus nanus perlasius** var. nov. [FIG. 80.]

A planta typico differt pilis pandentibus longissimis, foliis congestis et seminibus grandioribus; foliolis novem ad undecim, 20–25 mm. longis, alis 9–10 mm. latis, carina arcuatissima; leguminibus 30–35 mm. longis, 6 mm. latis; seminibus sex vel septem, 4 mm. longis, 3 mm. latis, linea atra prominenteque.

Differing from the typical plant in the very long, spreading pubescence, many hairs being 3 mm. long, the congested foliage, and the larger seeds: leaflets nine to eleven, 20–25 mm. long by 3–4 mm. wide; flowers 14 mm. long, wings 9–10 mm. wide, keel strongly arcuate; pods 30–35 mm. long by 6 mm. wide, ovules six or seven; seeds 4 × 3 mm., with a prominent, dark, lateral line.

CALIFORNIA. Mariposa County: Mariposa–Coulterville road, April, 1883, *J. W. Congdon* (TYPE, G).

Known only from the type specimen, a rather startling variation, probably as rare and local as it is odd.

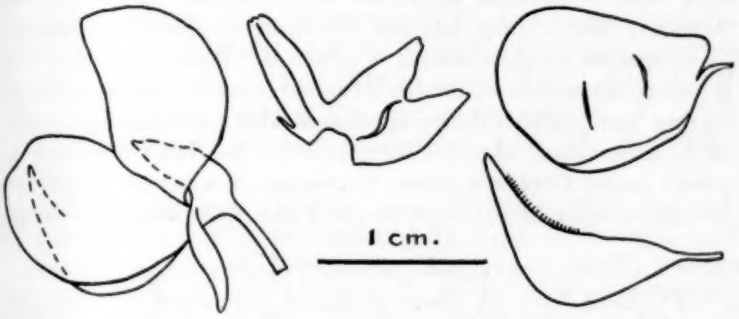

FIG. 80. LUPINUS NANUS PERLASIUS C. P. Smith. *J. W. Congdon*, April, 1883 (G).

1c. **Lupinus nanus carnosulus** (Greene) comb. nov. [FIG. 81.]

Lupinus carnosulus Greene, Bull. Cal. Acad. Sci. II. **6**: 144. 1886.
Lupinus affinis carnosulus (Greene) Jepson, Fl. West. Mid. Cal. 371. 1901.

Differing from the typical form in the size of the pods and seeds: largest leaflets 25-40 mm. long, 8-12 mm. wide; flowers 12-14 mm. long, keel not much curved; pods 30-50 mm. long 7-9 mm. ovules six to eight; seeds about 5 mm. long, 3-5 mm. wide, dark brown, heavily mottled.

Greene's original description is very brief but includes some interesting points. It is reproduced in full here:

> Annual, not slender, 1–2 feet high, somewhat succulent, finely pubescent, with appressed hairs: leaflets oblanceolate, an inch long, obtuse, but with a small, recurved cusp: racemes loose: bracts equalling the calyx, the upper lip of which is deeply cleft: corolla 5 lines long, deep blue throughout, keel naked: pods when young strongly villous-hirsute.
>
> Near the village of Olema, Marin County, April, 1886.
>
> Plant with the habit of large stages of *L. nanus*, but very distinct, wanting the variegated or changeable petals and villous-edged keel of that species; the herbage fleshy as in *L. affinis*.

The University of California has a sheet labelled, "*L. carnosulus* Greene, Olema, Marin County, April, 1886, E. L. Greene." This should therefore be a type-duplicate, if not the actual type; but some of the banners show a yellow center and white apex,

and the keel petals are actually ciliate as in *L. nanus*, although the ciliated edges are more or less curved inward so as to make the ciliation less conspicuous than usual. I could easily pass this specimen as a large phase of *L. nanus* without an inclination to seek even a varietal name for it. However, the California Academy has a sheet labelled the same as the above, except as to specific locality, which is given as "Point Reyes." This is a more marked variation from typical *L. nanus*, and agrees with certain San Mateo County specimens also identified by Greene as *L. carnosulus*. As this form is what has been accepted by others under Greene's name, I consider it wiser to suggest no change of name here, except to place the plant where it belongs,

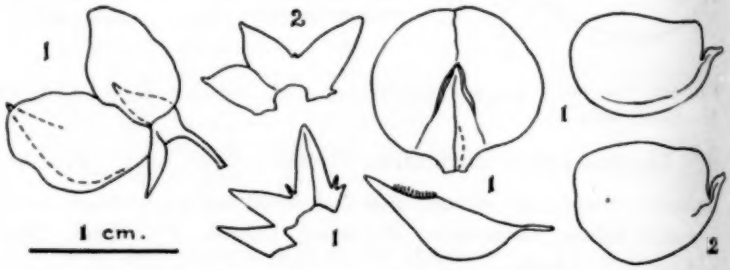

FIG. 81. LUPINUS NANUS CARNOSULUS (Greene) C. P. Smith. 1. *C. P. Smith 3290*, California (CPS); 2. *J. C. Nelson 3661*, Oregon (CPS).

as a variety of *L. nanus*. I have visited several of the localities where the variety has been found by others, both at flowering and fruiting season, and find the size of pods and seeds the only reliable characters for satisfactory identification. Miss Harriet L. Walker, in May, 1913, and myself, in May, 1921, visited Olema and vicinity seeking fruiting specimens and information concerning *L. carnosulus*. We each found *L. nanus, sensu stricto*, abundant and in full bloom, but no evidence of the large-fruited variety. However, Greene also took a plant at Olema, 16 April, 1886, which he labelled, "*L. nanus*" (UC 196349). I have seen no specimens with "naked keel."

CALIFORNIA. Contra Costa County: Oakland Hills, near tunnel, May, 1922, *C. P. Smith 3531* (CPS). Marin County: Point Reyes, April, 1886, *E. L. Greene* (CA). San Mateo County: Burlingame, May, 1895, *A. Eastwood* (CA); Crystal Springs Lake, April, 1896, *A. Eastwood* (UC); same, April

1902, *C. F. Baker 473* (BP, US) and *1728* (CA); LaHonda road, near summit, May, 1900, *W. R. Dudley* (CPS); Portola, April, 1903, *A. D. E. Elmer 5021* (CA, UC, US); San Mateo Canyon, April, 1921, *C. P. Smith 3290, 3292, 3293* (CPS); San Mateo Creek, April, 1895, *J. B. Davy 1087* (UC); San Mateo Ravine, April, 1894, *W. R. Dudley* (DS). Santa Clara County: Los Gatos, April, *T. S. Brandegee* (CA); Los Gatos foothills, April, 1904, *A. A. Heller 7298* (B, UC, US); Los Gatos Canyon, April 1894, *W. R. Dudley* (CPS); same, April, 1921, *C. P. Smith 3320, 3323, 3324* (CPS) and May, 1921, *C. P. Smith 3386* (CPS); near Stanford University, 1904, *W. R. Dudley* (CPS, DS).

OREGON. Benton County: near Corvallis, May, 1921, *J. C. Nelson 3661* (CPS); Lewisburg, July, 1922, *C. P. Smith 3568* (CPS). Douglas County: Riddle, May, 1922, *M. W. Gorman 5645* (CPS); Sutherlin, June, 1916, *M. E. Peck 5328* (WLU); Umpqua Valley, *T. Howell* (DS). Linn County: Eugene, May, 1920, *R. V. Bradshaw 1486* (CPS); same, May, 1921, *R. V. Bradshaw 2049* (CPS); same, April, 1922, *F. L. Wynd 921* (CPS). Marion County: Salem, May, 1911, *M. E. Peck 5454* (WLU).

1d. **Lupinus nanus Menkerae** var. nov. [FIG. 82.]

A *L. nano* typico differt leguminibus longis angustisque et seminibus 9–12; foliolis 10–15 mm. longis, floribus 10–12 mm. longis, vexillo emarginato, leguminibus 20–25 mm. longis, 3.5–4 mm. latis, seminibus 1.3–2 mm. longis pallido-carnosis paulo pallido-maculatis.

Differing from the typical form of the species in having the pods relatively long and narrow, and ovules nine to twelve; leaflets 10–15 mm. long, 2–3 mm. wide; flowers 10–12 mm. long, banner emarginate; pods 20–25 mm. long by 3.5–4 mm. wide, seeds 1.5–2 mm. long, pale flesh-colored, more or less spotted with a darker shade. While the color of the petals in the dried plants would pass as blue, except for the purple center of the banner, fresh plants sent me had pale lilac petals which turned decidedly bluish in the drying.

CALIFORNIA. Kern County: Bakersfield, April, 1896, *J. B. Davy 1707, 1925,* and *1930* (UC); same, April, 1905, *A. A. Heller 7588* (TYPE, B; type-duplicates, CPS, DS, UC); same, April, 1917, *A. Eastwood* (CA); same, April, 1922, *J. C.*

Menker & Edith Menker Smith 117 (CPS); Buena Vista hills, April, 1893, *A. Eastwood* (CA); Caliente, May, 1911, *K. Brandegee* (UC); Rosedale, March, 1900, *G. D. Abrams* (BP).

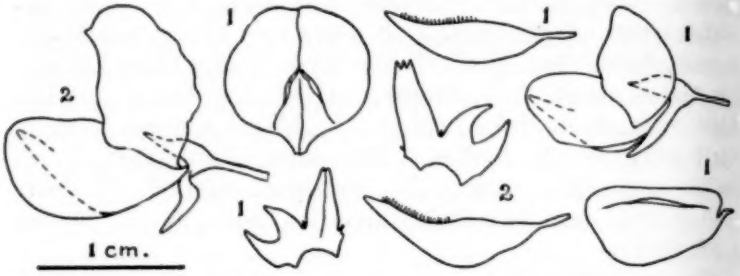

FIG. 82. LUPINUS NANUS MENKERAE C. P. Smith. 1. *A. A. Heller 7588* (B). 2. *A. A. Heller 7588* (CPS).

Heller (Muhlenbergia **2**: 63. 1905) recorded his observation that "this is not typical *nanus*, the leaves being narrower and the flowers smaller," but made no mention of the marked differences in the pods and seeds.

1e. **Lupinus nanus vallicola** (Heller) comb. nov. [FIG. 83.]

Lupinus persistens Heller, Muhlenbergia **2**: 62. 1905.
Lipinus vallicola Heller, ibid. **4**: 40. 1908.

Differs mainly from typical *L. nanus* in the smaller size of the flowers and the curvature of the keel; leaflets linear-oblanceolate, 10–25 mm. long, 2–4 mm. wide; flowers 6–10 mm. long, banner usually wider than long, its apex little separated from the united apices of the very wide wing petals, keel usually much curved; pods 15–25 mm. long, 4–5 mm. wide, ovules five to eight; seeds about 2.5 mm. long, pale flesh-colored, more or less mottled with a darker shade, often with a lateral line.

CALIFORNIA. Amador County: Jackson, June, 1904, *E. Mulliken 104* (B, BP, DS, UC); Sutter Creek, May, 1918, *Ann Wood* (DS). Butte County: Clear Creek—Paradise grade, May, 1902, *Heller & Brown 5530* (BP, DS); same, May, 1914, *A. A. Heller 11378* (CA, DS, UC, UCX); Cherokee Mine, April, 1919, *A. A. Heller 13105* (CA, UCX); Oroville—Forbestown road, May, 1915, *A. A. Heller 11890* (B, CA, DS, UCX). Calaveras County: Copperopolis, May, 1895, *J. B. Davy 1368* (UC). Eldorado County: Fyffe, July, 1908, *K. Brandegee* (UC); Pilot Hill, May, 1909, and April, 1915, *K. Brandegee*

(UC); near Tallac, June, 1893, *W. R. Dudley* (DS). Fresno County: Squaw Valley road, April, 1921, *P. B. Kennedy* (UCX). Kern County: Greenhorn Range, June, 1904, *Hall & Babcock 5040* (UC). Mariposa County: Crockers, May, 1895, *W. C. Blasdale* (UC); Hetch Hetchy Valley, July, 1902, *Hall & Babcock 3387* (UC); Wawona, June, 1911, *H. M. Hall 9007* (UC); Yosemite Valley, July, 1919, *S. S. Towne & E. P. Chase 4* (CPS). Nevada County: Penn Valley, May, 1919, *A. A. Heller 13185* (CA, UCX). Placer County: Colfax, May, 1907, *C. P. Smith 1280* (CPS); same, June, 1912, *A. Eastwood 495* (CA, CPS). Plumas County: Quincy, June, 1913, *A. A. Heller 10865* (CPS, DS, UCX); same, July, 1921, *C. P. Smith 3426*

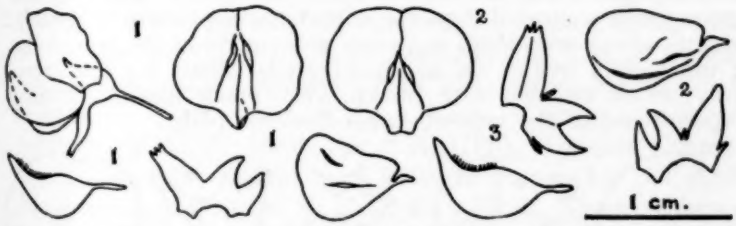

FIG. 83. LUPINUS NANUS VALLICOLA (Heller) C. P. Smith. 1. *A. A. Heller 7850*, Redding (B); 2. *A. A. Heller 10865*, Quincy (CPS); 3. *C. P. Smith 1280*, Colfax (CPS).

(CPS). Sacramento County: Folsom, April, 1916, *A. A. Heller 12316* (CA, DS, UCX); near Sacramento, April, 1918, *Edna Hannibal* (DS). Santa Clara County; below Wright, June, 1921, *C. P. Smith 3404* (CPS). Shasta County: Redding, May, 1905, *A. A. Heller 7850* (B, UC); Castella, July, 1912, *A. Eastwood 1396* (CA, CPS); McCloud River, May, 1918, *A. A. Heller* (CA, UCX); Stillwater, April, 1900, *M. S. Baker* (UC). Sierra County: Cedar Glen, May, 1920, *V. Jones* (CA). Sutter County: Marysville, March, 1905, *A. A. Heller 7555* (B, UC); Tuolumne County: Hetch Hetchy, June, 1889, *Chesnut & Drew* (UC); Middle Fork Tuolumne River, June, 1911, *H. M. Hall 8910* (UC). Yuba County: Los Virgils, May, 1921, *A. Eastwood 10552* (CA, CPS).

The above citations show that this is preeminently a form of the Sierra foothills, having been taken in at least seventeen counties, from Shasta to Kern, as far up in the mountains as Tallac, as low down in the valley as Marysville and Sacramento.

The one station in the coast region, near Wright, is along the railroad where coarse rock had been dumped, and it is evident that seed was brought in some way from the region of its natural range.

As the original descriptions of this and the next are readily available, they will not be reproduced here.

1f. **Lupinus nanus apricus** (Greene) comb. nov. [FIG. 84.]

Lupinus apricus Greene, Leaflets **2**: 67. 1910.
Lupinus vallicola apricus (Greene) C. P. Smith, Muhlenbergia **6**: 135. 1911.
Lupinus hirsutulus Greene, Leaflets **2**: 152. 1911.

Very much like var. *vallicola*, but the apex of the orbicular banner well separated from the united apices of the wing petals; leaflets 15–40 mm. long, 2–5 mm. wide; pods 15–25 mm. long, 4 mm. wide, ovules six to eight; seeds about 2.5 × 2 mm., gray, much mottled with brown, very much like a common type of seed of the typical, larger-flowered plant.

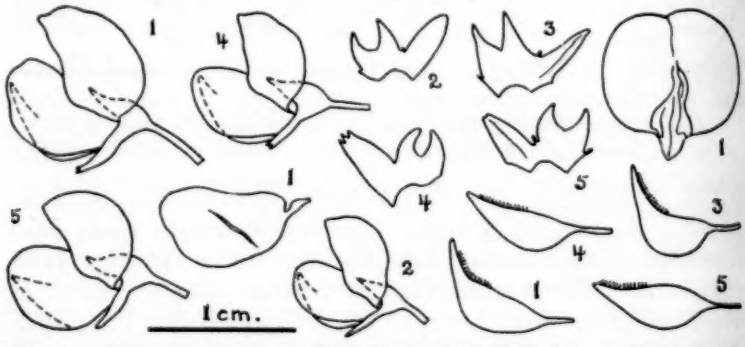

FIG. 84. LUPINUS NANUS APRICUS (Greene) C. P. Smith. 1 *C. P. Smith 1374*, Stanford University (CPS); 2. *C. P. Smith 1395*, Stanford University (CPS); 3. *L. R. Abrams 6473*, Monterey County (DS); 4. *A. A. Heller 10021*, Oregon (CPS); 5. *J. Macoun 78891*, Vancouver Island (B).

CALIFORNIA. Lake County: Burns Valley, April, 1902, *Agnes M. Bowman 154* (DS); Clear Lake, June, 1922, *E. A. McGregor* (CPS); Lakeport, May, 1903, *C. F. Baker 2960* (BP); same, May, 1917, *G. Bentley* (DS); Sulphur Banks, April, 1902, *Agnes M. Bowman 36* and *204* (DS). Mendocino County: Ukiah, June, 1913, *A. Eastwood* (CPS); near Ukiah, April, 1918, *L. R. Abrams 6991* and *7013* (DS). Monterey County: Kings City—Jolon grade, June, 1917, *L. R. Abrams*

6473 (DS); San Antonio Creek, May, 1895, *W. R. Dudley* (DS); Santa Lucia Mountains, April, 1908, *E. G. Dudley* (DS); Tassahara Hot Springs, June, 1901, *A. D. E. Elmer 3272* (DS). San Mateo County: Redwood City hills, April, 1921, *C. P. Smith 3289* (CPS); Woodside, hills north, *C. P. Smith 3498* (CPS); near Stanford University, April, 1908, *C. P. Smith 1374* (CPS, DS). Santa Clara County: Campbell, April, 1920, *H. A. Borthwick* (DS); Call-of-the-Wild, April, 1921, *C. P. Smith 3315* and *3316* (CPS); Gilroy, April, 1921, *C. P. Smith 3254* and *3255* (CPS); Los Gatos, April, 1897, *F. T. Bioletti* (UC); same, April, 1904, *A. A. Heller 7294a* (B, UC); Monte Bello Ridge, April, 1921, *C. P. Smith 3334* (CPS); Saratoga, March, 1921, *Edith M. Smith 101* (CPS); Stanford University, April, 1902, *C. F. Baker 610* (B, BP, CA, UC) and *644* (BP, CA, UC); same, April, 1902, *L. R. Abrams 2372* (DS); same, March, 1919, *Roxana S. Ferris 1467* (CPS). Shasta County: Anderson, April, 1913, *L. E. Smith 142* (CA, CPS). Sonoma County: Santa Rosa hills, March, 1902, *Heller & Brown 5115* (BP, DS); Santa Rosa, May, 1920, *G. H. Mallory* (DS). Trinity County: Weaverville, 1914, *H. S. Yates 292* (UC); same, April, 1915, *Anna A. Junkans* (CA).

OREGON. Curry County: Snow Camp, July, 1916, *J. H. Thompson 35* (DS). Josephine County: Gold Hill, May, 1916, *S. G. Jewett* (WLU); Grants Pass, May, 1910, *A. A. Heller 10021* (CA, CPS, DS, UCX); same, May, 1912, *H. S. Prescott* (CPS); same, April, 1913, *Lois Dale* (DS).

BRITISH COLUMBIA. Vancouver Island: Victoria, uplands, May, 1917, *W. B. Anderson* (PBC); Esquimault, May, 1908, *J. Maccun 78891* (B).

Like var. *carnosulus*, var. *apricus* was described by Greene as having a "naked" keel, whereas both are constantly ciliate as in *L. nanus*. For some years I have tried to accept var. *vallicola* as a good species; but I have repeatedly failed to find characters dependable for an accurate separation of the two. Too many puzzling intermediates have been secured, and some of these will probably continue to defy identification even by means of the varietal classification that I am offering herewith. Several additional varieties could be indicated, but not, as I now see it, to any good purpose, especially if based primarily upon pubescence. Thus *L. hirsutulus* Greene has at no time

gained my respect, and I am now unable to separate it from var. *apricus*, although it does seem to lean strongly toward *L. bicolor*, as the usual determination indicates. Many of my numbers of var. *apricus* have not been cited above. It is abundant in many localities of the foothills of the eastern edge of the Santa Cruz Mountains, from about San Carlos to Gilroy, apparently with a greatly interrupted or spasmodic distribution elsewhere.

The abbreviations used herein in the citation of specimens may be identified by reference to the following list:

B, Brooklyn Botanic Garden.

BP, C. F. Baker Herbarium, Pomona College, Claremont.

CA, California Academy of Science.

CPS, herbarium of the writer.

DS, Dudley Herbarium, Stanford University.

G, Gray Herbarium, Harvard University.

PBC, Provincial Museum, Victoria, British Columbia.

UC, Department of Botany, University of California.

UCX, Division of Agronomy, University of California Experiment Station.

US, United States National Herbarium.

WLU, Willamette University, Salem, Oregon.

SAN JOSE, CALIFORNIA

Tolypella longicoma in Cayuga Lake, New York

ROMYN HITCHCOCK

(WITH PLATE 8)

This species was originally described and named by A. Braun (1, p. 96) from specimens collected by Professor Lesquereux in swamps near Columbus, Ohio, in 1855. Allen (**2**) gives a translation of Braun's description with the comment: "I have been unable to obtain specimens of this species . . . I await its rediscovery." No later record of the species is to be found.

When collecting from the shore at the southeastern corner of Cayuga Lake, June, 26, 1921, I found a plant growing in tufts in the shoal water. On June 29, I collected the same plant from a boat in about four feet of water. The growth was abundant, covering the bottom in tufts about 15 cm. tall for square yards. The plants were fruiting finely in the upper whorls, the sporophydia and antheridia both being of a brilliant orange color. But as the fruiting was immature it seemed advisable to defer much collecting until a later day. This was unfortunate, for on July 11 the entire growth had disappeared. Only a few single plants could be found by selecting them from vigorous growths of *Chara*.

Such remarkably rapid growth, development and disintegration were not anticipated. However, Migula (**3**) states concerning plants of this genus: "They grow under favorable conditions remarkably fast and frequently reach in a few weeks their full size and development, whereupon they break up and disappear with the same quickness." As to *T. glomerata*, closely related to the Ithaca plant, he says that the spores ripen about the middle of April and that "immediately the plant breaks up and leaves no trace."

The next season, 1922, I began searching for the plant early in June but only on the 28th did I find a few single plants, brought up with charas, etc. Some of these showed protonemal growths with germinated spores attached. Repeated visits to the location during July and August failed to disclose any

noticeable growth of the plant where it was so abundant the year before. Perhaps the excessive early rainfall, which raised the water level and carried more sediment than usual, may account for this.

The plant was first entered in my notes as *T. comosa* Allen, which was found in Seneca Lake in August, 1882. But *T. comosa* has considerably larger spores and differs in other minor respects. On further study there seems no doubt that the plant is most nearly related to *T. longicoma* and that it can not be specifically separated therefrom. The Cayuga Lake plant is smaller and somewhat incrusted, the spores are black with seven or eight striae (not brown as described by Braun), and they ripen in July; otherwise there is no difference.

The general habit of growth is shown in FIG. 1, which represents an entire young plant from the node above the protonema. Four conspicuous stem-branches have developed from the node, and these bear fruiting heads at the upper verticils. The close fruiting of the upper verticils of well-grown plants is shown in FIG. 5 and, somewhat enlarged, in FIG. 4.

The sterile leaves which arise in verticils from the lower stem nodes are simple, very long, of uniform diameter throughout (not "slightly attenuate" as Braun observed), about 0.2 mm. in diameter, and with blunt, rounded, and incurved ends. They are usually three-celled, with the terminal cell the longest, and may attain a length of 5 cm., thus exceeding the stem internode above.

The fertile leaves divide near the base but have only one leaflet-forming and fruiting node, bearing an antheridium between two sporophydia and normally three short leaflets, two lateral and one dorsal, with a relatively long leaf terminal (FIGS. 2, 3). The long terminals and leaflets are three-celled, not attenuate and are blunt-rounded. The first leaf-segment may be very short, 1–2 mm. or less, or considerably longer, and the terminal extension may be 2–3 cm. long or more. This is the typical form of fruiting leaves, but in the close-fruiting heads they are naturally quite small and, as Braun remarks, "the lateral leaflets either do not develop on the inner leaves of the smaller fertile heads, or, at least, are so dwarfed as to be indistinguishable."

The heads are made up of verticils of fruiting leaves at the ends of very short stem branches within the upper large stem verticils. Braun writes: "fertile verticils bunched; bunches complicated by axilliary shoots." Doubtless the "axilliary shoots" are the stem branches mentioned and this reference to the structure of the heads tends to confirm the species relation. The stem branches may be 2–5 mm. in length or less, with whorls of six or seven fertile leaves having very short basal segments.

Antheridia are usually sessile but occasionally are borne on pedicels equaling their own diameter. Sporophydia are sometimes very short stiped —my impression is that this applies only to those which develop in the fundus of a verticil.

As the spores ripen for fertilization the neck-cells of the sporostegium become greatly enlarged (see FIGS. 6, 7). Such conspicuous enlargement is not common in the family but is notable in *T. glomerata* and in *Nitella opaca*, which also is found about Ithaca. I have not seen the processes of fertilization but I have seen the opening of antheridia and the swimming sperms. Now, with plants of this family generally, mature fruits may be found in the lower verticils, while the earlier stages may be seen above. Therefore it is remarkable, if the number of specimens I have collected during two seasons is considered, that I have not found on a growing plant a single mature fruit, such as is required to determine the markings and color of the mature spore. Possibly my collection at the time when sporophydia and antheridia were numerous happened to be made a few days before any fruit had matured on any of the plants. In less than ten days thereafter the plants had utterly disappeared. There is here a gap in my record much to be deplored.

In other species the cells of the sporostegium become active after fertilization in forming a lignified, colored membrane around the spore, which may have various thickenings or spiral striae. I have not been able to discover any indication of the development of such a spore membrane in any growing plant collected. By careful manipulation the sporostegium envelope may be separated from the young spore which is then seen to have a thin, hyaline coat well filled with starch. One such spore is shown in FIG. 7. Many such dissections have failed to reveal any indication of further membrane development.

Nevertheless, the usual lignified membrane forms, and perhaps cultures in glass would make it possible to follow the development of the spores after fertilization, although my own efforts in that direction have not succeeded. The only examples of mature spores I have found are two germinated spores on one of my herbarium sheets marked "protonemal growth and spore cases," June 26, 1921. These date back to the year before and were still connected with the protonemas and plants developed therefrom. They were removed and mounted for microscopical examination and are shown in FIG. 8.

The author's measurements of the Cayuga Lake plant may be compared with Braun's measurements of the Columbus plant as follows:—

	Author	Braun
Antheridia	0.37–0.44 mm.	0.36 mm.
Sporophydia		
Length	0.35–0.57 mm.	0.38–0.6 mm.
Width	0.4 mm.	0.42–0.44 mm.
Spores		
Length	0.3–0.38 mm.	0.36–0.4 mm.
Width	0.3–0.34 mm.	0.3–0.32 mm.
Crown		
Height	35 μ	
Width	85 μ	

ITHACA, NEW YORK

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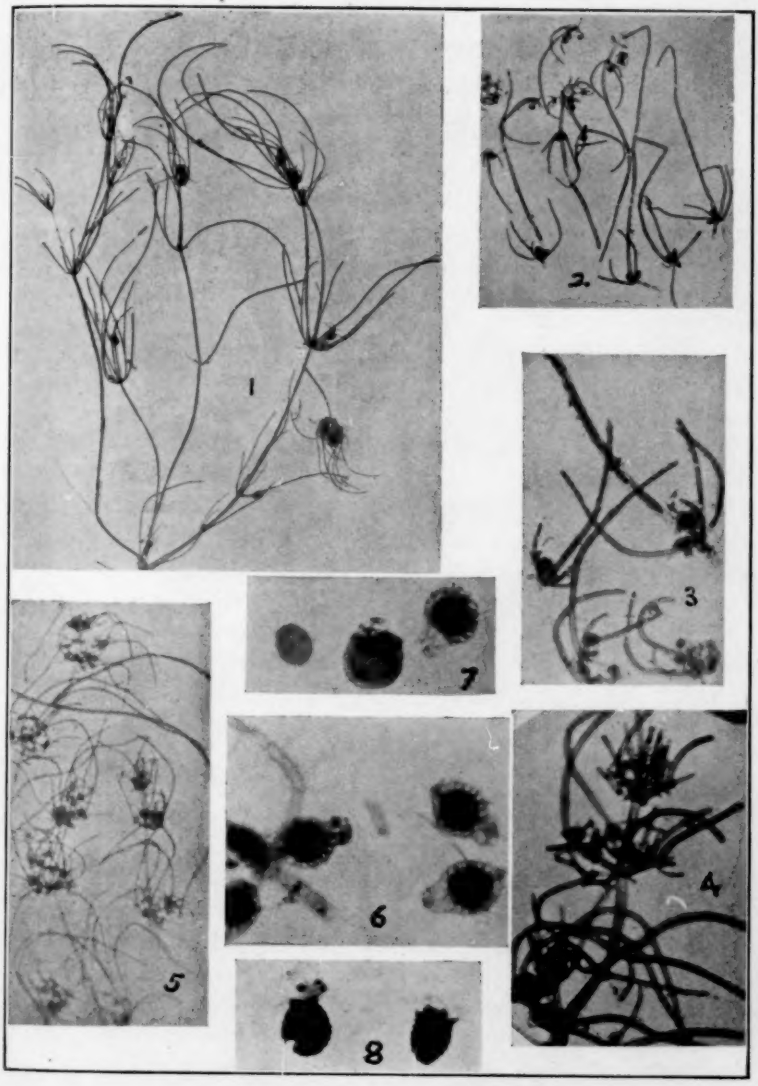
1. **Braun, A.** Fragmente einer Monographie der Characeen. Abhandl. Königl. Akad. Wiss. Berlin **1882**: 1–211. *pl.* 1–7. 1883.
2. **Allen, T. F.** Notes on the American species of *Tolypella*. Bull. Torrey Club **10**: 109–117. *pl. 37–42*. 1883.
3. **Migula, W.** Die Characeen. Rabenhorst's Kryptogamenflora **5**. 1900.

Explanation of plate 8

TOLYPELLA LONGICOMA A. BR.

FIG. 1. Plant, natural size.
FIG. 2. Fertile leaves.
FIG. 3. Fertile leaves.
FIG. 4. Enlarged verticils of fertile leaves.
FIG. 5. Fruiting heads.
FIG. 6. Sporophydia, neck-cells enlarged.
FIG. 7. Two sporophydia and dissected out young spore.
FIG. 8. Germinated spores (from dried specimen).



TOLYPELLA LONGICOMA A. BR.

Notes on Fabaceae—I

PER AXEL RYDBERG

HOMALOBUS Nutt.

For several years I have worked on genera of the Fabaceae for the North American Flora. Two parts containing the tribe Psoraleae have already been published, and the manuscript for the Indigoferae and a large part of the Galegeae is ready. My work has taken me to *Astragalus* and related genera. I have heard a rumor that M. E. Jones has been working on an illustrated revision of *Astragalus*, and I wish that this had been published so that I could have availed myself of it in my studies. It would perhaps have helped me to avoid some of the errors which are so likely to creep in.

There is little room for critical notes in the Flora, and yet notes of this character are necessary for a proper understanding of my disposition of genera and for a just appreciation of the amount of work that I have done on the group. It is my intention, therefore, to publish a series of preliminary notes in order to thresh out any unavoidable criticism, which might come from certain quarters, before my final monograph is published. If I should criticise any fellow botanist in this undertaking I do it in order to bring out the facts.

Just before the present paper was completed there appeared an article by J. F. Macbride, entitled: A revision of *Astragalus*, subgenus *Homalobus*, in the Rocky Mountains.* Now it may perhaps seem superfluous for me to go into details and publish another paper on the same subject so soon. So far as generic and specific limits are concerned, I do not think that either Macbride or Jones can ever agree with me. It surprises me, however, that so many of my species, even some that had been sneered at by Jones, have been accepted by Macbride. That he should have reduced some of my species to varieties I might have expected, since I do not see where to draw lines between species and varieties and prefer a binomial name to a trinomial

* Contr. Gray Herb. II. 65: 28–39. 1922.

for the sake of convenience. He has not treated me more harshly in this respect than he has others; for he has reduced to varieties or synonyms the species of other botanists, such as *Astragalus lingulatus* Sheld., *A. exiliflorus* A. Nels., *Homolobus caespitosus* Nutt., *H. canescens* Nutt., *H. brachycarpus* Nutt., *A. amphidoxus* Blankinship, *H. dispar* Nutt., *H. junceus* Nutt., *A. junciformis* A. Nels., *A. diversifolius* Gray, *A. strigosus* Coult. & Fish., *A. Palliseri* Gray, and *A. acerbus* Sheld. In this way he has reduced half of Nuttall's species, all of A. Nelson's and all but one of Sheldon's. Is such a reduction warranted?

I once criticised Brand for his work on the Polemoniaceae, because he did not try to find what the types really represented. May I not now have the right to criticise Macbride for the same laxities? In his paper on *Homalobus* he reduced my *H. microcarpus*, *H. proximus*, and *H. Salidae*, although he admitted that he had not seen the types; he reduced also my *H. Clementis*, *H. stipitatus* and *H. uniflorus*, without including the types among the specimens cited, thus implying that he did not have them before him. The same can be said about Sheldon's *Astragalus lingulatus* and *A. acerbus*. Except in the case of *A. lingulatus* the types of all these species are readily accessible to anyone who may wish to see them.

As I have not found it necessary to change essentially my grouping of the species from that published in my Flora of the Rocky Mountains, I shall keep the same groups as there. I shall also omit the keys except in cases where the species are from the Pacific coast. Keys would be superfluous, since my own are found in my Flora of the Rocky Mountains and since Macbride has given a good one in the paper cited above.

A. CAESPITOSI

1. HOMALOBUS CAESPITOSUS Nutt. This is the most common and best known of the group, and its nomenclature has not been much confused. Occasionally the leaves are two- or three-foliolate instead of simple. *H. canescens* Nutt. is only a more silvery form of the species. Gray, who merged *Homolobus* in *Astragalus*, recognized the identity of the two, retaining the specific name *caespitosus*, although there was an earlier

Astragalus caespitosus Pallas. On this account Sheldon substituted the name *A. spatulatus*. In the meantime O. Kuntze had transferred all species of *Astragalus* to *Tragacantha*. M. E. Jones* has made *A. caespitosus* a variety of *A. simplicifolius* (Nutt.) A. Gray, probably because he did not understand the latter species, which is discussed below. Macbride has followed Jones.

2. HOMALOBUS BRACHYCARPUS Nutt. Gray, Watson, Sheldon, Jones, and Macbride have regarded this as a synonym of *H. caespitosus*. Nuttall distinguished it by its shorter, broader and more abruptly acute pod and by its smaller size. I take it to be the same as the plant described and figured by Watson in King's Report under the name *Astragalus simplicifolius* Gray, although the leaves of Nuttall's specimens are narrower than those figured by Watson. Evidently Jones has followed Watson in his interpretation, for he has shown the close relationship between what he called *A. simplicifolius* and *A. caespitosus*, and afterwards went so far as to make the latter a variety of *A. simplicifolius*. The plant described and figured by Watson, however, is not the same as *Phaca simplicifolia* Nutt.; if it is not *H. brachycarpus* it is without a name. The duplicate of Nuttall's type of *H. brachycarpus* in the Torrey Herbarium strongly resembles Watson's plant but is somewhat taller and has narrower leaves. That in the Gray Herbarium is different and is exactly like the type of *H. canescens*; it does not agree with the description of *H. brachycarpus*. The following specimens belong to the latter:—

WYOMING: hills on the Platte, *Nuttall*; northwestern Wyoming, *Jones 68*; Big Horn Mountains, *Tweedy 136*; Laramie Plains, 1897, *Osterhout*; Fort Steele, *Tweedy 4193*; Pine Bluffs, *A. Nelson 2877*; Natrona, *A. Nelson 142*; Laramie, *A. Nelson 31, 7289*; Fort Bridger, *Lauderdale*.

UTAH: Unitah Mountains, *Goodding 1285*; Wasatch Mountains, *Watson 289*.

3. HOMALOBUS SIMPLICIFOLIUS (Nutt.) Rydb. There are several points in the original description of Nuttall's *Phaca simplicifolia* that do not fit Watson's plant, such as the following: "scapes 1–2-flowered, scarcely exserted;" "legumes glabrous,

* Proc. Calif. Acad. II. 5: 647. 1895.

coriaceous, sessile, somewhat triquetrous, pointed, scarcely longer than the calyx;" "flowers ochroleucous." In Watson's plant the scape is three- to seven flowered, usually as long as, or longer than, the leaves; the pod is decidedly flat; and the corolla is purple. All the characters given by Nuttall fit *A. exiliflorus* A. Nelson, but I do not think that the two are identical. There is, however, a plant of southern Wyoming and northern Colorado that agrees fully with Nuttall's type. This resembles Nelson's species but is smaller and has shorter leaves. In this respect it approaches *H. brachycarpus*, being distinguished from that species by its narrower and more pungent leaves and by its shorter, unmottled, and rather turgid pod, thicker nearer the lower suture than the upper, hence Nuttall's expression, "somewhat triquetrous." Nuttall's specimen in the Gray Herbarium has leaves only, so that Watson had no opportunity to compare the pods. The following specimens belong to this species:—

WYOMING: Rocky Mountains, *Nuttall; Fremont;* Ham's Fork, *C. C. Curtis*; Green River, *Jones*; Hanna, *Payson & Payson 1694*.

COLORADO: Canon City, *Brandegee*.

4. HOMALOBUS EXILIFOLIUS (A. Nels.) Rydb. See notes under the preceding species. The following specimens belong here:—

WYOMING: Freezeout Hill, *Elias Nelson 4493*; Fort Steele, *Tweedy 4194*.

5. HOMALOBUS LINGULATUS (Sheld.) Rydb. This is known only from the original collection, and its description is much like that of the preceding species, the only essential difference being the glabrous calyx. The mature fruit is unknown. When the plant is better understood it may prove to be the same as *H. exilifolius*, in which case the species should bear Sheldon's specific name, which antedates Nelson's by five years.

6. HOMALOBUS UNIFLORUS Rydb. It is possible that this may represent an aberrant form of *H. brachycarpus*, i.e. *Astragalus simplicifolius*, as understood by Watson. The pod, however, is different, being lanceolate in outline, more tapering at the apex, 6–7 mm. long and 2–3 mm. wide. It is, therefore,

more like that of the true *H. simplicifolius*.* The following specimens may be cited:—

WYOMING: Evanston, *A. Nelson 2971* (flower); Carter, *M. E. Jones* (fruit).

B. TENELLI

7. HOMALOBUS TENELLUS (Pursh) Britton. The description of *Astragalus tenellus* Pursh, dating from 1814, was drawn (according to Pursh himself) from flowering specimens of the present species and the fruit of some other *Astragalus*, both of which had been collected by Lewis. When Pursh found that his description had been based on a mixture, he redescribed the flowering specimens, associating them with a fruiting plant collected by Bradbury on the Upper Missouri and giving the species the new name *Ervum multiflorum*, on account of its *Ervum*-like pods. A fragment of Bradbury's plant in the Torrey Herbarium is clearly identical with the flowering specimens collected by Lewis: hence there is no doubt that *Astragalus tenellus* (so far as the flowering specimens are concerned) and *Ervum multiflorum* are the same.

8. HOMALOBUS DISPAR Nutt. Nuttall first described this species in 1818 under the name *Orobus dispar*, from specimens that he collected at Fort Mandan. To those who consider *H. dispar* and *H. tenellus* identical, this note will be of no interest. It is here presented, however, for the benefit of those who are willing to admit their distinctness as species or varieties. Since Nuttall and Bradbury were members of the same expedition and often collected together, one might perhaps assume that *Orobus dispar* and *Ervum multiflorum* were the same. They are not. Nuttall's specimen in the Torrey Herbarium agrees with his description in having broader leaflets than *H. tenellus* and broader short-stipitate pods. Of *Phaca nigrescens* Hook., which was described in 1830 from specimens collected by Richardson, there is likewise a duplicate in the Torrey Herbarium. This belongs to *H. dispar*, while a specimen collected by Nuttall on the Platte River, which was named *Homalobus nigrescens* by him and *Astragalus multiflorus* by Hooker, is like *A. tenellus* Pursh. Macbride states correctly that "Nuttall's

* See also Bull. Torrey Club **34**: 49. 1917.

specimen in the Gray Herbarium has narrowly linear leaflets and the stipe of even very immature pods is quite as long as the calyx." These statements do fit Nuttall's specimens of "*H. nigrescens*" in the Torrey Herbarium but not his description of *H. dispar*. The specimens in question were collected on the Missouri, but I do not know the date; there is no evidence that they came from Fort Mandan.

9. HOMALOBUS STIPITATUS Rydb. Although *H. tenellus* is much more common than *H. dispar*, the two species have nearly the same range; *H. stipitatus* is confined to the northeastern part of this range. All the specimens in the New York Botanical Garden Herbarium are cited under the original description and need not be repeated here.

10. HOMALOBUS STRIGULOSUS Rydb. Macbride has reduced this to *Astragalus tenellus* forma *strigulosus*. An additional specimen is here recorded:—

UTAH: Jugtown, *Jones 5400*.

11. **Homalobus Standleyi** sp. nov.

Astragalus tenellus var. *Clementis* Macbride, Contr. Gray Herb. II. **65**: 35 (in part). 1922.

A perennial, with a caespitose caudex; stems 2–3 dm. high, sparingly strigose; stipules deltoid, about 2 mm. long, connate; leaves 3–5 cm. long; leaflets nine to fifteen, elliptic or oblong, 5–10 mm. long, 2–3 mm. wide, glabrous above, strigose beneath; racemes lax, 4–7 cm. long, including the short peduncle; bracts lance-subulate, 1–2 mm. long; calyx strigose, the tube 2 mm. long, the teeth subulate, fully 1 mm. long; corolla white or tinged with purple, the keel purple-tipped; banner 6 mm. long, obovate, slightly retuse; wings 5 mm. long; keel-petals 5 mm. long, with a rounded apex; pod about 1 cm. long, 3 mm. broad, strigose, elliptic-oblong, acute at each end, short-stipitate, the stipe shorter than the calyx-tube.

TYPE collected at Ponchuelo Creek, New Mexico, July 4, 1908, *Standley 4181* (herbarium of the New York Botanical Garden).

This is closely related to *H. strigulosus* but differs in the white or purple-tinged (not ochroleucous) corolla, with a decidedly purple-tipped keel, and in the narrower pods with much shorter stipes. Macbride thought that this belonged to *H. Clementis* Rydb. and, on account of the similarity of the pod

to that of *H. strigulosus*, made *H. Clementis* a variety of *Astragalus tenellus*. He had evidently not seen the type or a duplicate of the type of *H. Clementis*, but had seen specimens of *Baker 489* from Marshall Pass, Colorado, which evidently belong to *H. Clementis*. In our specimen of this number the pods are very immature, but a closer examination would have shown Macbride that Baker's plant and *Standley 4181* were not the same. In the type of *H. Clementis* the pods are half broader than in *H. Standleyi*, distinctly black-hairy and tapering at both ends, but the stipe if any is only a fraction of a millimeter long, i. e. the pod is subsessile; the corolla also is much larger. *Baker 489* also has black-hairy pods.

12. HOMALOBUS ACERBUS (Sheld.) Rydb. Macbride reduced this species to *Astragalus tenellus* forma *acerbus*, but had evidently seen no specimens of it. M. E. Jones has referred the type of *A. acerbus* in the Columbia Herbarium to *A. wingatanus* and expressed his views in print.* as follows: "*Astragalus acerbus* seems to be identical with *A. Dodgeanus* Jones, and the latter is not surely separable from *A. wingatensis* [*wingatanus*]." In *H. tenellus* and its closer relatives the corolla is ochroleucous (not a very important character); the racemes, together with the peduncles, seldom overtop the leaves to any extent; the pods are decidedly veiny; and the plants are inclined to blacken in drying. In *H. acerbus*, on the other hand, the corolla is white or purple-tinged; the racemes are twice to four times as long as the leaves; the venation of the pods is indistinct; and the plants show no inclination to blacken. The following specimens belong here:—

COLORADO: Glenwood Springs, 1893, *Saunders*; DeBeque, *Osterhout 4282*; Grand Junction, 1895, *M. E. Jones*.

13. HOMALOBUS DODGEANUS (M. E. Jones) Rydb. At present I have no authentic specimens of this species before me but, according to my memory, it is very closely related to *H. acerbus*, and Jones, as shown above, regards the two as identical. In fact Jones's own specimens, determined by him as *Astragalus Dodgeanus*, from Grand Junction, collected May 22, 1895, represent *H. acerbus* and are here listed under that species.

* Proc. Calif. Acad. II. 5: 636. 1895.

The type came from Thompson's Springs, Utah. The decidedly oblique pods and black-hairy calyx of *H. Dodgeanus* would make the species distinct enough, if these features should prove constant; otherwise the two species should perhaps be united. In this case Jones's specific name should be retained.

14. HOMALOBUS CLEMENTIS Rydb. See my notes under *H. Standleyi* above. Notwithstanding Macbride's remarks and his reduction of this species to a variety of *Astragalus tenellus*, I still consider it nearest to *H. wingatanus* and worthy of recognition. In both *H. wingatanus* and the allied *H. lancearius* the pod is acute at each end, as in *H. Clementis*, and a minute stipe is sometimes produced. In *H. lancearius*, in fact, this stipe may be fully as long as in *H. Clementis*. The following specimens may be cited:—

COLORADO: Saugre de Cristo, *Clements*; Marshall Pass, *Baker 489*; without locality, *C. H. Hall.*

15. HOMALOBUS WINGATANUS (S. Wats.) Rydb. To the specimens listed by Macbride the following may be added:—

COLORADO: Mancus, *Eastwood.*

UTAH: Monticello, *Rydberg & Garrett 9151, 9228.*

16. HOMALOBUS LANCEARIUS (A. Gray) Rydb. This species is still known with certainty only from the type collection: Beaver Dam, Arizona, 1877, *Palmer 114*. A flowering specimen from Allen Canyon in southeastern Utah, *Rydberg & Garrett 9309*, resembles the type very much but is doubtful in the absence of fruit. In the original description of *Astragalus lancearius*, Gray called attention to the fact that the species strongly resembled *A. filipes* in habit and in flowers, but that the pod was perfectly sessile. On this account it would have to be placed in the *Tenelli* group, probably near *H. wingatanus* and *H. acerbus*. Jones* claimed that the species was the same as *Astragalus recurvus* Greene, which on account of its completely two-celled fruit is a species of *Hamosa*. Later he† retracted his statement, adding that *A. lancearius* was "a good species but near *A. Rusbyi* Greene." The first part of his conclusion is correct but the latter part is far from the mark.

17. HOMALOBUS EPISCOPUS (S. Wats.) Rydb. Under *Astragalus Coltoni* Jones, Macbride makes the following statement:

* Proc. Calif. Acad. II. **5**: 636. 1895.

† Contr. West. Bot. **8**: 12. 1898.

"Rydberg's reduction . . . of this species to *A. episcopus*, a plant with strictly sessile pods, is not understandable." The explanation of this reduction is as follows. In the herbarium of Columbia University there is a sheet labelled: "Coll. United States Department of Agriculture. *Astragalus Episcopus*, S. Watson, n. sp. Locality Utah. Collector, Capt. Bishop, 1872." The specimens on the sheet are more or less broken up into pieces but the habit is very similar to that of *A. Coltoni*, as represented by our specimens collected at Castle Gate by Jones. The plants are in flower, but the color of the corolla can not be determined. There is also a broken immature pod, showing a stipe nearly 1 cm. long. On the same sheet is a pocket containing two pods; one of these is mature and of exactly the same shape as the pods of *A. Coltoni* (except that the stipe is broken off), while the other is very young but shows a stipe 7 mm. long. On the pocket is written in what I take to be Watson's hand, "*Astragalus episcopus*, Wats. S. Utah. Capt. Bishop, 1873. pods." These specimens in the Columbia University Herbarium clearly belong to the same species as *A. Coltoni*. Macbride's statement that the pod of *A. episcopus* is "sessile" does not agree either with the type specimen or with Watson's description, which reads: "pod narrowly oblanceolate, compressed, 1¼ inches long, 2½ lines broad, acute at each end, very shortly stipitate, reflexed." Watson's description, however, agrees in every respect with the Columbia University specimens, except the words "very shortly;" for the stipe is rather long. As Watson also describes the flowers as being "purple or yellowish," he might have had a mixture, and if the specimens in the Columbia Herbarium were included in his conception of the species, this was certainly the case. The specimen in the Gray Herbarium is also fragmentary but shows a plant related to *H. lancearius*; its pod, however, is larger, 3 cm. long, and 5–6 mm. broad, tapering at both ends and very shortly stipitate, and the corolla is larger, being fully 12 mm. long.

18. HOMALOBUS VEXILLIFLEXUS (Sheld.) Rydb. This was originally described as *Astragalus pauciflorus* Hook.; since, however, there is an older *A. pauciflorus* Pallas., Hooker's specific name is not tenable in *Astragalus* and hence not in *Homalobus*. As the plant is well known no specimens need be cited.

H. miser (Dougl.) Rydb. should be withdrawn, at least provisionally. My conception of it was partly based on Gray's interpretation of the species, when he included under it *Lyall 7*, a specimen in flower only. Jones and Piper have referred this specimen to *Astragalus microcystis* A. Gray, a species of *Phaca*. I do not feel certain that their identification is correct or that Lyall's specimen really represents *Astragalus miser* Dougl. Since Gray placed the species among the *Homalobi* and since I at that time identified certain slender specimens in fruit with Lyall's plant, I admitted *H. miser* as valid. I now think that the true *A. miser* is still to be identified.

C. BOURGOVIANI

This group bears the name of *Debiles* in my Flora of the Rocky Mountains. It is desirable to change the name, however, since *Astragalus debilis* (Nutt.) A. Gray, as will be shown below, is an imperfectly known species.

19. HOMALOBUS BOURGOVII (A. Gray) Rydb. The habit and the black-hairy calyx and pod make this plant resemble a good deal *Astragalus alpinus* L. and *Phaca elegans* Hook., both now belonging to other genera. Except for the somewhat ridged valves of the pod the plant is a true *Homalobus*. In the alpine regions of the Canadian Rockies there grows a low, almost acaulescent form, with minute leaflets. This looks very unlike the ordinary form, but all grades between the two extremes are found.

20. **Homalobus retusus** sp. nov.

A perennial, with a slender caespitose rootstock; stems decumbent or ascending, 1–2 dm. long; stipules lanceolate or the lower ovate or triangular, connate, 1–2 mm. long; leaves 5–8 cm. long; leaflets nine to eleven, oblong to oval, often retuse or emarginate, 5–12 mm. long, 2–4 mm. wide, glabrous above, sparingly strigose beneath; peduncles 6–10 cm. long, slender; racemes short, five- to ten-flowered, bracts lanceolate, 2 mm. long; calyx black-hairy, the tube 2 mm. long, the teeth subulate, 1 mm. long; corolla purplish; banner 8–9 mm. long, obovate; wings 7–8 mm. long, the blade obliquely oblanceolate, with a long basal auricle; keel-petals slightly shorter, with a rounded apex; pod black-hairy, sessile, 8 mm. long, 3.5 mm. wide.

TYPE collected at Fort Selkirk, Yukon, July 20, 1899, *Tarleton 128, a & b* (herbarium of the New York Botanical Garden). The following specimens in flower may belong here:—

YUKON: Ranch Valley, *Gorman 1082;* White Horse, *Macoun 58429*.

When I transferred *Astragalus debilis* (*Phaca debilis* Nutt.) to *Homalobus*, I thought that the specimens above cited belonged to it and drew the characters of the pod from them. I have since found that they represent a species close to *H. Bourgovii*. M. E. Jones identifies *Phaca debilis*, with *Astragalus Bodini* Sheld., which is a true *Phaca* related to *P. microcystis*. A duplicate of the type of *P. debilis*, which is in the Torrey Herbarium, somewhat resembles *P. Bodini* in habit, but the calyx is not black-hairy and the leaflets are emarginate. Macbride admits *Astragalus debilis* as a member of the subgenus *Homalobus*, citing the following two species from Colorado: North Park, *Osterhout 3*, and Upper Platte, *Geyer 3*. The latter I have not seen but Osterhout's plant clearly belongs to *P. Bodini*. Osterhout had labelled it "*Astragalus debilis*," apparently following Jones's interpretation. Until the fruit is discovered, I fear that *P. debilis* can not be fully interpreted.

Astragalus grallator S. Wats. is regarded by M. E. Jones as an abnormal form of *A. Haydenianus*, and I am inclined to agree to this view. In this case the species should be removed from *Homalobus*. The specimen of *A. grallator* in the Torrey Herbarium, so named by Watson, is a similar abnormal form of some other species.

INDEX TO AMERICAN BOTANICAL LITERATURE
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The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in the broadest sense.

Reviews, and papers that relate exclusively to foresty, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

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